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From educating science teachers towards educating stem teachers

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FROM EDUCATING SCIENCE TEACHERS TOWARDS EDUCATING STEM TEACHERS

Science teacher education across Europe is organised in multiple ways. The most common ways to distinguish between approaches is to i) distinguish between university college education and university education and ii) to distinguish between specialised teacher training or general teacher training (European Commission (EC), 2006, 2011a, 2011b). Within the recent years the Danish teacher educational systems, which is categorised as specialised university college teacher training, there has been a movement from education teachers in single science topics towards educating teachers as interdisciplinary teachers with focus on the interplay between mathematics, biology, chemistry, geography and physics. Here the set-up and preliminary results from an investigation on the establishment and further development of interdisciplinary STEM approaches to science teacher education are presented. The organisation of specialised science teacher profiles was mapped according to official documents and interviews with coordinators at the respective institutions. To unfold experiences with such profiles follow-up focus groups interviews were conducted with representation from both leaders and teachers from all university colleges. Student experiences were also captured through interviews. Preliminary results show that all teacher education institutions in Denmark have established or are about to establish specialised interdisciplinary science profiles in their teacher education. Organisation of such profiles is often an extra burden to the administration; especially if the profiles are established in cooperation with a university. Students attending the profiles see themselves as special students and data indicates that although they have extra ECTS in their study time the students come out with equal results as students attending the ordinary teacher education. The pros and cons for interdisciplinary vs. topic specific teacher education are discussed.

Keywords: STEM education, Interdisciplinarity, Curriculum

INTRODUCTION

Science teacher education can be organised in many ways. Each country finds its own model and some places for instance in Germany the teacher education differs from region to region. These conditions make it hard to compare teacher education between countries, even though that was the purpose in large EU reports on science and mathematics teacher education (European Commission (EC), 2006, 2011a, 2011b). In these reports teacher education is found either at university colleges or at universities and for some countries both depending on the educational level the teachers are trained for. Furthermore there was a distinction between generalist and specialist teacher training. These distinctions were made due to considerations if the teacher training were solely a pedagogical study or if teacher training had specialisation within different content areas like physics or mathematics. The Danish teacher education was in such context labelled as a specialist teacher training on university college level for primary and lower secondary teachers and on university level for upper secondary teachers.

In this study we examine the science teacher education at lower secondary level. In the ordinary teacher education the students can choose between many specialisation subjects including science subjects, but they are not restricted to choose science subjects. Within the past years a new teacher education profile have risen where students are bound to specialisation within mathematics and science with focus on interdisciplinarity between the science subjects. The aim of this study is to unfold contributions and challenges in educating interdisciplinary teachers instead of course specific specialists from the research question:

What do Danish student teachers educated for teaching lower secondary school gain from attending an interdisciplinary science profile, and what challenges are found?
To answer such questions we have focused on both teacher students and on teacher trainers and administrators from teacher training.

**BACKGROUND**

Ordinary Danish teacher training for lower secondary school is a four year education with in all 240 ECTS. During their study the students specialise in three different topics during courses of 40 – 50 ECTS for each subject. Students can choose between all subjects and there is no demand that the chosen subjects are connected in any way. With the challenges in science education and recruitment for science careers (see e.g. Osborne & Dillon, 2008) there has been a demand for strengthening teachers subject knowledge and pedagogical content knowledge (McNeil et al., 2016). Such demands have led to establishing specialised science teacher educations. By having specialisations solely within science topics and mathematics it becomes possible to use the synergy between the topics and thereby education teachers with specialisation in four topics. In 2018 the Danish Ministry of Education granted a project to map, evaluate and develop such specialised science teacher training profiles.

**METHODOLOGY**

The project was unfolded in three separate phases, namely i) a mapping of existing profiles and the organisation of these, ii) collecting experiences with the science teacher profiles from both teacher trainers, administrators and students, and iii) a workshop with teacher trainers and students from different profiles on how to use the experiences from different profiles to enhance science teacher profiles in the future. In order to answer the research question a mixed method research design was developed. For the first phase we used an analysis of existing documents on each profile as well as interview with the coordinators from each of the detected profiles. This phase was carried out during the summer 2017. The second phase was informed by both focus group interviews with teacher trainers and administrators as well as questionnaires and interviews with students attending a science teacher profile. A questionnaire was also handed out to ordinary teacher students with specialisation in mathematics but not attending a science teacher profile education. These students were the best reference group for comparison between ordinary teacher education and science teacher profiles (Goldbech et al., 2018). The second phase was carried out in autumn 2018 and spring 2019. The third phase is to sum up the experiences and share knowledge across science teacher profiles in order to qualify future profiles even more. This is to held as a workshop in early summer 2019

**PRELIMINARY FINDINGS**

As this is a work in progress it is only possible to present preliminary results from phase i) and partly from phase ii). The mapping of specialised science teacher education profiles showed that all but one university college had established such a profile and the last university college intend to start their profile in 2019. Each of the profiles has their origin in local ideas on a science teacher profile and there has not been much collaboration in the development of the different profiles. All profiles but one use the synergy between science subjects and mathematics to specialise students in four areas; the last profile offers a science supervisor education and engineering education instead. All profiles offer more ECTS to the students on science profiles than to ordinary teacher students.

Both teacher trainers and administrators find that students attending a science profile see themselves as special students in contrast to students attending the ordinary teacher education. Examinations show that teachers attending a science profile get as good results as teachers on the ordinary teacher education even that the profile teachers have a more compressed study.

Both teacher trainers and administrators find that the interdisciplinary approach is for the better and teachers attending the science profile gain the same or an even better understanding for their four specialisation areas than do teacher students on the ordinary education in their three specialisation areas.

**DISCUSSION**

The establishment of specialised science teacher profiles seems to be positive in the perspective of teacher trainers and administrators, but critical voices has also been raised on the compressions and loss of subject
knowledge in the interdisciplinary approach. The positive mind-set on interdisciplinarity is supported by research where e.g. Latucca, Fath & Voigt (2004) argue that that interdisciplinary teaching can be both motivating, present content in a broader view, help overcoming overlapping content knowledge and develop holistic thinking among students. It can though be discussed if such holistic view is narrowed down by being interdisciplinary only within science and mathematics and thereby loosing perspectives for instance to social science and arts. The current discussion on STEM education calls for teachers prepared to work with all aspects of STEM and here it seems that teachers with the interdisciplinary approach from a science profile are better prepared.

Another issue of discussion is the exclusivity of the students. Findings show that students see themselves as special, but it raises the question if such profiles could exclude teachers from the ordinary teacher education from science topics in that they are not special enough to blend with the profile students. These and many more questions will be addressed in the last part of the project.

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